

## Social Ecology and Group Cohesion in Pilot Whales and their Responses to Playback of Anthropogenic and Natural Sounds

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### LONG-TERM GOALS

This project investigates the social ecology and cohesion of long-finned pilot whales as part of a broad multi-investigator research program that seeks to understand how cetaceans are affected by mid-frequency sonar and other sources of anthropogenic noise. The study of how noise affects large delphinids such as pilot whales is important since these species have different social systems and seem to respond differently to anthropogenic noise sources such as sonar (Curé et al., 2012) compared to beaked whales (DeRuiter et al., 2013; Tyack et al., 2011). However, the baseline behavior of pelagic delphinids is much less well understood compared to beaked whales, making both design and interpretation of controlled exposure experiments difficult (Miller et al., 2012). For gregarious species relying on social strategies to defend against potential predators or competitors, the size, composition and cohesion of the natal group as well as the dive activity of group members likely plays an important role in shaping the decision processes of individuals and to determine the degree of response to a potential threat. Our goal here is to study the social dynamics and effects of noise on group-living delphinids. We aim to gather data to design, conduct and interpret controlled exposure experiments to social delphinids such as pilot whales, with the ultimate goal of understanding responses to naval sonar and improving Navy environmental analyses.

### OBJECTIVES

The specific objectives of this research project are to: a) collect additional baseline data on pilot whale behavior in a social context, by simultaneously tagging multiple individuals within the same group to study social coordination and group cohesion and how these social dynamics might influence reactions to distance. b) to tag individuals multiple times across field seasons to study stability of bonds and stereotypy of calls. c) to quantify surface group cohesion, speed and orientation of social animals using stereo photogrammetric geocoding in combination with tag data. d) to perform sound playbacks to a subset of tagged animals to evaluate behavioral response patterns, and e) to evaluate the feasibility of estimating dose:response functions for untagged animals.

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## **APPROACH**

This project supports a 1-month field expedition to the Strait of Gibraltar, Spain. We will be working with the non-profit research organization CIRCE ([www.circe.info](http://www.circe.info)) and based out of the Port of Tarifa. The aim of this research expedition is to instrument multiple close associates within the same social group with sound and movement recording DTAGs (Johnson and Tyack, 2003). These tags sample a pair of hydrophones, a depth sensor, an 3-axis accelerometer and magnetometers. Following successful tagging, we will track animals visually and using radio beacons on tags while collecting focal-follow data. When conditions allow, we will perform controlled playback experiments of natural and anthropogenic signals to tagged animals when the group is in a travelling mode at the surface. During these experiments, we will quantify surface responses from a smaller follow boat using a stereo camera system that quantifies the position and orientation of individuals and which allows for quantifying surface cohesion over time.

## **WORK COMPLETED**

The fieldwork for this project was originally scheduled to take place during the summer of 2014. However, due to the delays with the federal budget for fiscal year 2014 and the resulting late award notice, we have pushed the planned expedition to the summer of 2015.

## **RESULTS**

With the expedition pushed to the summer of 2015, we have no results to report on this project yet.

## **IMPACT/APPLICATIONS**

The proposed research is part of a broad multi-investigator research program that seeks to compare responses of beaked whales and other odontocetes to playbacks of mid-frequency sonar sounds vs other anthropogenic signals. These projects aim to define exposure:response functions for risk to beaked and other whale species for exposure to naval sonars, and to suggest improvements for mitigation. The potential impacts and causal mechanisms behind these are becoming increasingly well known in the case of beaked whales (Moretti et al., 2014; Tyack et al., 2011). Strandings of pilot whales have been reported during naval sonar exercises (Hohn et al., 2006) and while these incidents provide only weak evidence for a link between sound exposure and stranding, they suggest the need to investigate the potential impacts on delphinids. Our proposed study here seeks to understand the baseline behaviour of pilot whales in a social context that relies upon repeated work with the same individuals, which can only be completed in this field site. Our proposed project will provide essential data for how to structure playbacks and analysis for current and future playback studies. This project will provide information on the typical responses to biologically relevant (killer whale and conspecific) and anthropogenic (mid-frequency sonar) sound stimuli that will be analysed in a collaborative effort with other research groups with similar playback protocols. Our simultaneous tagging approach is also the only current method for estimating accurate individual and group vocal rates for social odontocetes, and the only way of understanding the influence of sociality on diving behaviour and reaction to disturbances.

## RELATED PROJECTS

P. L. Tyack and A. Bocconcelli: Tagging and Playback studies of toothed whales (N000140910528) preceeded this project with previous work on long-finned pilot whales in the Alboran Sea.

P. L. Tyack and A. Bocconcelli: Baseline behavior of pilot whales and their responses to playback of anthropogenic and natural sounds (N000141410417) continues this project with a new field season in 2015 to retag some of the previously tagged pilot whale groups, and increase playback sample size with a redesigned playback protocol.

## REFERENCES

**Curé, C., Antunes, R., Samarra, F., Alves, A. C., Visser, F., Kvadsheim, P. H. and Miller, P. J. O.** (2012). Pilot Whales Attracted to Killer Whale Sounds: Acoustically-Mediated Interspecific Interactions in Cetaceans. *PLoS ONE* **7**, e52201.

**DeRuiter, S. L., Southall, B. L., Calambokidis, J., Zimmer, W. M. X., Sadykova, D., Falcone, E. A., Friedlaender, A. S., Joseph, J. E., Moretti, D., Schorr, G. S. et al.** (2013). First direct measurements of behavioural responses by Cuvier's beaked whales to mid-frequency active sonar. *Biology Letters* **9**.

**Hohn, A. A., Rothstein, D. S., Harms, C. A. and Southall, B. L.** (2006). Report on Marine Mammal Unusual Mortality Event UMESE0501Sp: Multispecies Mass Stranding of Pilot Whales (*Globicephala macrorhynchus*), Minke Whale (*Balaenoptera acutorostrata*), and Dwarf Sperm Whales (*Kogia sima*) in North Carolina on 15-16 January 2005. NOAA Technical Memorandum NMFS-SEFSC, 537.

**Johnson, M. P. and Tyack, P. L.** (2003). A digital acoustic recording tag for measuring the response of wild marine mammals to sound. *Ieee Journal of Oceanic Engineering* **28**, 3-12.

**Miller, P. J. O., Kvadsheim, P. H., Lam, F. P. A., Wensveen, P. J., Antunes, R., Alves, A. C., Visser, F., Kleivane, L., Tyack, P. L. and Sivle, L. D.** (2012). The Severity of Behavioral Changes Observed During Experimental Exposures of Killer (*Orcinus orca*), Long-Finned Pilot (*Globicephala melas*), and Sperm (*Physeter macrocephalus*) Whales to Naval Sonar. *Aquatic Mammals* **38**, 362-401.

**Moretti, D., Thomas, L., Marques, T., Harwood, J., Dilley, A., Neales, B., Shaffer, J., McCarthy, E., New, L., Jarvis, S. et al.** (2014). A Risk Function for Behavioral Disruption of Blainville's Beaked Whales (<italic>Mesoplodon densirostris</italic>) from Mid-Frequency Active Sonar. *PLoS ONE* **9**, e85064.

**Tyack, P. L., Zimmer, W. M. X., Moretti, D., Southall, B. L., Claridge, D. E., Durban, J. W., Clark, C. W., D'Amico, A., DiMarzio, N., Jarvis, S. et al.** (2011). Beaked Whales Respond to Simulated and Actual Navy Sonar. *PLoS ONE* **6**, e17009.